

R E P O R T S

MADE, BY DIRECTION OF THE SECRETARY OF STATE,

BY

E. H. OSBORN, Esq.,

ONE OF H.M. INSPECTORS OF FACTORIES,

UPON THE

CONDITIONS OF WORK, &c.

IN

FLAX MILLS AND LINEN FACTORIES

IN THE

UNITED KINGDOM;

WITH APPENDICES.

Presented to both Houses of Parliament by Command of Her Majesty.



LONDON:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C., and
32, ABINGDON STREET, WESTMINSTER, S.W.; or
JOHN MENZIES & Co., 12, LANOVER STREET, EDINBURGH, and
90, WEST NILE STREET, GLASGOW; or
HODGES, FIGGIS, & Co., LIMITED, 104, GRAFTON STREET, DUBLIN.

1894.

[C.—7287.] Price 3s.

CONTENTS.

I.—REPORT OF AN INQUIRY IN THE CITY OF BELFAST, IN 1891	Page 1
II.—SUPPLEMENTARY REPORT, AS TO FLAX MILLS AND LINEN FACTORIES IN THE UNITED KINGDOM	14

I.

Report of an Inquiry into the Conditions of Work in the Belfast Flax Mills and Linen Factories, and into the Mortality among Textile Operatives, &c., in the City of Belfast during 1891.

SYNOPSIS.

Scope of inquiry.
Sources of information.
A defect in registration statistics.
Comparative mortalities.
Belfast, by position, unhealthy.
Estimates of its population.
Number of textile operatives.
Some death-rates and averages.
Inadequate clothing.
Insufficient diet.

Weaving Factories.

Classified.
Excessive humidity.
Bad ventilation.
Suggestions.

Wet Spinning Rooms.

Ventilation of.
Spinnets and doffers.
Damp clothing.
Absence of hygrometers.
Suggestion re waterproofs.

Roughing and Sorting Rooms.

Excessive dust.
Its effects.
Ventilation of.
A good method of lessening dust.

Machine Hauling Rooms.

Excessive dust.
Improved ventilation of.
Analysis of flax worker's lung.

Preparation and Carding Rooms.

Excessive dust.
Dust pans for drawing frames at York Street Mills.
Remedies for dust at York Road Mills.
" " Ligoniel.
" " Manchester.

Dressing Rooms.

High temperatures.
Health of dressers.
General remarks and inferences.
" Mili fever."
Infectiousness of phthisis and periodical medical inspection.

APPENDICES.

A., B., C., and A.—Tables of deaths.

I., II., III.—Hygrometrical details.

My investigations in Belfast, with the results embodied in this Report, embraced a complete analysis of the causes of mortality among the city population, in each sex separately, from 10 years of age upwards, during the year 1891; and incidentally a corrected estimate of the mortality among textile operatives proper (Table A), as compared with that furnished to the Secretary of State (Table B), which I found to include all persons engaged in any kind of factory, whether textile or non-textile, and therefore to be to that extent in excess of the actual mortality among persons employed in the various processes connected with the spinning and manufacturing of flax and other fibres of analogous nature.

In examining how far the conditions under which these processes are carried on may be unfavourable to health, I visited all the weaving factories, some more than once as seemed desirable, and took a large series of careful hygrometrical observations, which will be found tabulated in convenient form for reference (Tables I. and II.); similar observations were also taken in a sufficient number of wet-spinning rooms (Table III.) to indicate their average atmospheres; the presence of dust and modes of ventilation where existent were duly noted; and collateral information was obtained from all available sources. And here I desire to acknowledge the facilities everywhere readily accorded to me and the intelligent interest taken in my observations by managers and employers, who evince great desire to adopt any means that may tend to ameliorate the conditions of work, wisely recognising that every improvement in the health of their workpeople means better quality and quantity of work. Special thanks are also due to my colleague, Mr. Snape, who was at pains to provide me a concise census of

the number employed; to the experienced Superintendent Medical Officer of Health, Dr. Whitaker, for his annual report; and to Mr. Nelson, the Superintendent Registrar, who kindly gave me access to the Registers and placed a private office at my service while examining them.

All attempts to arrive at accurate statistics of mortality among an industrial population encounter this difficulty on the threshold, that in the cases of widows and married women only the occupation of the husband is given, so that there is no record of say they may themselves have followed prior to marriage: this lacuna was strongly apparent in 1883 when accurate knowledge of the death-rate among weavers in Blackburn was desiderated, and is again in evidence in the case of Belfast where a preponderating number of women over men are employed in the textile factories: this is all probability explains the apparently marked decrease in the number of deaths after 30 years of age among female mill hands, when compared with the ratio of all other classes among whom they and their work-histories become merged by wifehood, so far as the registers are concerned, where phthisis claimed girl-wives of 17, 18, 19, and 20 years of age. It is impossible to take even a cursory glance at the Tables A and C and not be struck by the facts that the deaths from phthisis and respiratory diseases are more than half of the total from all causes (2,237 to 4,151): that the deaths among textile operatives from phthisis, &c. are 284 to 180 from other causes, and that up to 30 years of age the deaths from phthisis among females are, of mill-hands 120, to 285 of all other classes, clearly pointing to the existence of some special conditions affecting textile operatives, as distinguished from the ordinary pre-disposing causes common to the major portion of the community. These special conditions may be summarised as dust, damp, heat, and imperfect ventilation, for all which remedies or at least palliatives are certainly not undiscoverable. Dr. Whitaker well points out that "Belfast is not, and, from the nature of its position and soil, can never be a very healthy city. Built on the estuary of the Lagan—on the mudbanks reclaimed from that river—a large portion of the city is scarcely above high-water mark. The soil is heavy, retentive, and impervious, in the upper districts generally stiff clay. We have little sunshine; an undue proportion of moisture in the air, a high ground water, and our mean temperature is lower than that of any of the large urban districts in Ireland." The population of Belfast is estimated by Dr. Whitaker as about 275,000; by Mr. Nelson as nearer 300,000 (based upon its 60,000 houses); by the Registrar-General's return as 265,000.

The number of operatives engaged upon textile fibres is 30,000, of whom some five-sixths are females. The general death-rate in 1873 (population, 200,348) was 23·8 per 1,000; in 1891, 25·5 per 1,000; in 1892, 26·1 per 1,000; and for the last decade 24·7.

Phthisis and respiratory diseases averaged in 1873, 10·6 deaths per 1,000 of population; in 1892, 10·9 deaths per 1,000; so that the ratio remains nearly the same, notwithstanding the assumably improved sanitation during the last 30 years; but the poorer families perforce gravitate to the cheaper and less desirable tenements, which with insufficient food and inadequate clothing are common predisposing factors in any large aggregate of population.

I could not fail to notice that, as in Lancashire, the use of flannel is "conspicuous by its absence" from the clothing of the operatives, who wear merely linens or cottons, which retain moisture and cause chills, thus adding to the perils of work in heated atmospheres. The staple diet of the majority of the women would also seem to be chiefly bread and tea, four times a day, the latter stewed with the sugar in it which effectively extracts the maximum of tannin and certainly induces chronic dyspepsia. Many of the children I found on inquiry have porridge, eggs, or potatoes, but those of poorer physique generally proved to be living upon the tea and bread régime. The cheap meals provided by some employers at cost price and without charge for cooking do not seem so much appreciated as they should be.

Leaving the habits of the people, noteworthy from their bearing upon the general health, the specially unhealthy conditions that attach to the various processes of flax manufacture in each department may now be dealt with seriatim, to be followed by practical suggestions for their amelioration.

Weaving Factories.

All these, 42 in number, were visited, in some cases twice for more extended observation. They will be found divided into two groups (Tables I. and II.), Table II. consisting of the damask-weaving rooms, where steam is not infused, as damp would

damage the pattern cards and top-hammer of the Jacquard looms; and with these are classed also the rooms where unions (cotton warp and linen weft) are manufactured of material already bleached, &c. In this group there is generally little dust apparent, but what there is consists of very small particles of flax filament kept in suspension while the looms are in motion. The ventilation in all sheds is defective, and the atmosphere close and oppressive.

Of the sheds in Table I. it will be observed that in 13 out of the 29 the humidity reached saturation or within a degree of it, while in some cases where observations were taken at several points, there were variations both of temperature and of humidity which deserve notice, because while it was stated that the finer counts of linen yarn require high temperature and a maximum humidity, the weavers in the lower temperatures were doing as well as those where temperature and humidity were highest.

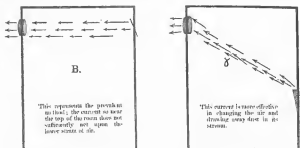
It is all "rule of thumb" and tradition, the steam is generally infused from uncovered pipes at a considerable heat as will be seen from some tests given in the Table I., so that the pipes radiate at any rate an equal heat to that of the steam they convey and raise the temperature needlessly; the pressure is also unnecessarily high, and the amount of condensation very great, the floors being quite wet. Of course there is no dust under such circumstances, but in the absence of proper ventilation the atmosphere is close and unwholesome, since with complete saturation evaporation from the body ceases, simply because there is no room for the body moisture to evaporate into, hence increase of body temperature above normal (98°), and consequently more or less physical distress; besides this the thin bodies of the women become damp, adding to the risks of bronchitis and other analogous ailments on going into the outer air, besides the dangerous temptation to enjoy deep inspirations of the cool outside atmosphere. Doubtless where the physique is robust it may become acclimatised to these conditions which will remain perilous to those of weaker constitution. In one shed visited shortly after 5 p.m., where saturation prevailed, the steam was blowing in at full blast, the place so filled with vapour it was impossible to see half-way its length; the jets were directed downwards, impinging upon the bodies of the weavers and the garments they would go home in, and after standing in the midst of the jet for two minutes the back of my hand was moist enough to damp a strip of litmus paper. At another factory where saturation was already reached a weaver asked me to come later on in the afternoon again to see what it was like, but there was no necessity for seeing more, as it was then bad enough. No such state of things ever existed in Lancashire before the Cotton Cloth Act, as the weaving of a sized cotton warp in such an atmosphere would be impossible. The system is unreasonable and wasteful, resembling nothing so much as the Chinese extravagance immortalised by Elia, of burning a house to roast a pig; for I satisfied myself by feeling the warp threads coming into weaving, and on the beam, that the result is not commensurate with the steam expended; and am inclined to think the size or "dressing" which usually consists of flour, tallow, and Irish moss may be too "hard" and might be softened by the use of a deliquescent to attract moisture. A manufacturer to whom I mentioned this promises to experiment in this direction, and has also written me since my departure that he finds his weaving not impaired by keeping humidity two degrees below the dry temperature. He adds: "I am certain from the figures you" are quite right about relative degrees and amount of moisture contained in the "air," and "that the theory of the more heat" (supposed to be necessary for fine work) "is all wrong." If it were also necessary for the warp to be absolutely moist, then menus of local application should be contrivable without the atmosphere of a vapour bath for the operatives. Economy and efficiency alike dictate that wherever humidity is produced by steam-jets these should be so arranged as not to impinge upon the workers, the pipes should be covered with non-conducting composition, and the steam injected at low pressure, which also means a lower temperature for the room.

Suggestions.

1. Improved ventilation: on the fan-system successfully adopted in Lancashire under the Cotton Cloth Act (one 14- or 15- inch extracting fan for every 2,500 square feet of floor surface).
2. Regulated humidity: a difference of two degrees always to be kept between the wet- and dry- bulbs (e.g., dry-bulb, 75°; wet-bulb, 73°). This avoids the necessity for a complex schedule, and allows adequate humidity for practical purposes.
3. Hygrometers to be affixed, &c. adopting the rules of the Cotton Cloth Act, as to their being kept in working order, and readings registered, &c.

Wet Spinning Rooms.

Hygrometrical observations recorded in 21 rooms will be found in Table III.; a number of others were visited and tested but presented no special features not included in those subjected to more lengthened observation. In the cases where saturation was reached it appeared to arise from imperfect ventilation; the best conditions existed where the ventilation was good, and the pipes conveying the steam to the troughs jacketed. A common error in the arrangements for ventilating is that the windows on the same side of the room as the fans are open, which naturally lessens the cross-current which would be maintained if only the range opposite the fans were open. These openings also are as a rule too near the top of the room for the best ventilation, as may be understood from these diagrams:—



The highest humidity was in the *coarse* (low) spinning rooms, where the fibre is said to need greater heat in the water to render it supple and spinnable, but that high temperature and humidity are not inseparable from coarse spinning is seen in the readings (78°, 72°) of No. 18 (Table III.).

Special scrutiny was given to the persons employed in the wet spinning, as here the majority of children are employed, for whom 10 hours of the heat and vapour seem a long day's work; and changes from the heated air to the cold outside air conducive to chest affections. I noticed particularly that for several inches above the waist the clothing of the boys and girls, especially of the shorter ones, was saturated by the fine spray from the spindles. As here are the most delicate organs of the human frame, the danger of developing lung diseases at an early age where the constitution is weak or predisposed must be enhanced by this continuously damp clothing, worn all day, with, in cold weather especially, sharp alternations from heat to cold. The majority of these "doffers" that I saw in the schools visited appeared however in fairly good health, though, in many cases, of evidently poor stamina, and inferior in growth to children of the same age in Lancashire.

Hygrometers are not in use in any of these rooms, where they would be a valuable aid to managers in ascertaining and regulating the atmospheric states.

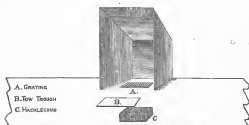
Suggestion.

Seeing that the waterproof "overall" is simply an apron, affording no protection from the spindle spray above the waist, it should be made with a "bib" to protect the chest also, and be worn by all.

"Roughing" and "Sorting Rooms."

The "dusty" processes have now to be dealt with. The "Rougher" performs the initial process of separating the "line" (or fine fibre) from the "tow" (or coarse and shorter fibre), and the "Sorter" deals similarly with the "line" according to its qualities. In both operations the work is similar, consisting of drawing the fibre by "stricks" or handfuls through a coarse or finer comb of steel hackles. They work in a continual cloud of dust composed of large and small particles of the fibre, which is inhaled, and irritates and dries the throat and gradually finds its way into the lungs, producing "chronic inflammation of the lining membrane, which soon manifests its presence by the worker being attacked each morning with a paroxysm of dyspnoea

"and coughing." A worker suffering thus is said to be "poucey" (pouce = dust = poussière). Most of these workers whom I questioned had experience more or less of this condition, as might be expected from the state of the air. Some roughing rooms have no ventilation but windows opening at the upper part, and the workers face the wall, which of course reverberates the dust upon them, which lays the foundation of "mechanical phthisis." Other rooms, more modern, are large and lofty, and provided with powerful fans, but still dusty. The best arrangement I saw was at the York Street Mills, where a trunk exhausted by a large fan runs along the side of the room with a metal hood opposite each berth, and a grating through which the dust is drawn forward and down from the face of the workman. I give a sketch out of perspective to make it clearer.



It seems very desirable that some similar, possibly simpler and less expensive, mode of exhausting the dust below the breathing line should be generally or compulsorily adopted, for it is the finer dust that rises and is most insidious, the heavier particles sooner falling.

Machine Hacking Rooms.

Here the fibres are further combed by machinery, tended by boys upon a staging to reach their work, which evolves a large quantity of fine dust. Sometimes "roughing" goes on also in these rooms, some of which are very bad, and the lads powdered with dust. I have seen in Manchester a machine-room freer from dust than any in Belfast, fans being placed on the side of the room where the machines are, and inlets provided in the opposite windows about 6 feet from the ground (on the principle shown in diagram "γ" page 4). The late Dr. C. D. Purdon states that "when the machine boys become 'poucey' numbers of them leave the mills on account of suffering from chest affections and go to other trades, where they linger out a diseased existence or die from phthisis."

It may be noted that in two cases of flax-workers' phthisis, 100 grains of incinerated lung gave (1) 3·881 of ash, of which 0·227 was silica;

(2) 2·609 " " 0·47 "

indicating the presence of flax-dust, of which silica is a constituent.

Preparation and Card Rooms.

Dust is again the distinguishing feature of these departments, where the work is carried on by women, among whom Dr. Purdon, in 1872, states the mortality as 31 per 1,000; and Dr. Whitaker, in his report on the health of Belfast, 1892, says, "the carder's average length of life is only 16·8 years (of work). If a girl gets a card at 18 her life is generally terminated at 30. The preparer's average is 28·7 years of work." "Mechanical feeders" somewhat lessen the dust, and fans remove more, but it is quickly apparent upon the air, &c. after a short while of work.

In the York Street Mills the drawing frames are being provided with shallow metal trays placed below the rollers, which catch the dust and prevent it falling to the ground and being suspended in the air, and in their York Road Mills a large trunk has been constructed below the carding engines with a powerful fan which prevents a large quantity of dust from rising. This is, however, a costly plan, for which also there would not be space everywhere. At Ligoniel small steam-jets appeared to materially lessen the dust, and might perhaps produce good effect in the preparation room; and

in the Messrs. Renshaw's flax-mills in Manchester a similar result seems to be achieved by the use of a moderate humidity. There is, however, still room for improvements, which may possibly be found in a better distribution of more fans of smaller size than the fewer large ones generally adopted: for instance, an 18-inch fan between each two carding engines with a diagonal draw from the opposite side (as in Diagram "γ").

Dressing Rooms.

"Dressing" or sizing the warps is carried on in the old-fashioned way formerly common in Lancashire also, before the introduction of "slashing;" and the warp is dried by a highly heated atmosphere instead of being passed over heated cylinders. Hence the temperature of these rooms is always high; 101° and 117° were the highest noted. The common saying, "no one ever sees a dresser's funeral" implies that the men are generally healthy; and such is their appearance. Dry heat can be borne with little distress, as the body temperature is kept normal (98°) by the evaporation set up from and through the skin. With temperate living and reasonable prudence when leaving work for the outer air a robust constitution should experience no ill-effects. It may be observed that as hot air in motion is a quicker drier than hot air stagnant, the use of fans here must benefit alike the worker and the work.

Experience has made it clear that the lassitude caused by damp heat is materially lessened by good ventilation and reduction of humidity within reasonable limits; and dusty occupations are notably palliated by constantly changing the air, and it is evident from the mortality statistics, coupled with observations that dust is the predominant factor in conducing to respiratory disorders in the flax-processes, and should therefore be diminished as much as possible. It is to be regretted that respirators are so disliked by both sexes, as they would be of material benefit in this direction.

Other ailments to which women are subject are common to all occupations that involve standing for a long time.

Doffers, &c. in the wet spinning are often attacked on first employment with what is called "mill fever" after a few days of work. The late Dr. Purdon says: "No treatment is required or sought for, as the worker knows it means a certain course and will leave him comparatively well but rather weak for a few days, when he may return to work without any fear of taking it again." An experienced schoolmistress, however, informed me that sometimes the effect was observable for as long as a month. In such cases there must be considerable constitutional disturbance and certainly atony; and it is remarkable that no tonic treatment appears to be tried either as prophylactic or redintegrative, since a child or young person must, for a time under such circumstances, furnish a favourable nidus for the development of any zymotic or other ailment to which there may be constitutional predisposition.

Now also that phthisis is recognised to be an infectious disease, it is worth consideration whether some periodical medical inspection of children and young persons might not be desirable in the interests of the State as well as of the individual, where a special disease seems so cognate with the employment.

I have now gone through the various matters which formed the subjects of investigation, and in bringing this report to a conclusion venture to hope that no important point upon which information was desired has escaped observation.

E. H. OSBORN.

APPENDICES.

TABLE A.—Corrected Table of Deaths of Flax and Linen Factory Operatives in Belfast, 1891.

- " B.—Table of Deaths of "Millhands" in Belfast, 1891, as handed to the Secretary of State, and forwarded from Home Office for examination.
- " C.—Deaths of all "other classes" in Belfast, 1891, from 10 years of age upwards, shown separately for each sex, for comparison with Table A. similarly set out.

TABLE I.—Hygrometrical observations in humidified sheds.

- " II.—Hygrometrical observations in non-humidified sheds.
- " III.—Hygrometrical observations in wet spinning rooms.

TABLE A.

OCCUPATIONAL TABLE of DEATHS of FLEET and LARVE FLEETWORK OPERATIONS in BELFAST, 1901.

Age.	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	Total
Fleetmen	3	11	44	35	35	36	11	3	1	3	—	—	—	—	—	100
Explosive fitters	3	3	3	3	3	3	10	10	11	3	3	3	3	1	—	55
All other men	4	20	19	7	17	13	10	3	3	7	7	3	3	3	3	130
Total	11	32	62	48	48	48	24	16	11	11	10	10	10	5	5	285

TABLE B.

TABLE of DEATHS of "BLANKET" in BELFAST, 1901, as headed to the SECRETARIAT OF STATE.

Age.	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	Total
Fleetmen	3	10	30	40	33	13	11	3	1	3	—	—	—	—	—	100
Explosive fitters	1	3	3	3	10	10	10	15	11	11	3	10	4	3	1	114
All other men	3	17	17	3	21	14	12	14	7	3	3	10	3	7	1	170
Total	3	29	50	47	64	37	33	30	20	21	12	20	10	10	2	384
Excess Space of Table B	—	50	35	11	3	3	4	3	1	3	3	10	3	3	—	149

EXCESS TOTALS of DEATHS, QUANT. of, TABLE B

Fleetmen	41
Explosive fitters	55
All other men	53

Note.—The difference in these Tables arises from the fact that Table A contains all deaths of persons employed in all industries in Belfast, while B, only those of persons employed in the spinning and weaving of flax within Belfast, viz. = all textile deaths.

Monetary Taxes, showing District of Taxable Grosses (A) and of Ass. Gross Classes (C) in RETURN CRY for 1992 from Ten Years of Age, arranged in Quinquennial Periods separately for each Sex.

It may be noted that among Females deaths from Diseases in A: C are: 8: 51 from 18-19 years.

- - - - - A. C. 58-74 - 18-19 -
 - - - - - A. C. 55-75 - 20-25 -
 - - - - - A. C. 55-57 - 55-59 -

TABLE A.—TAXABLE GROSSES.

	Male		Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		Female		Totals	
	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate	Age	Rate		
Age	10-14		15-19		20-24		25-29		30-34		35-39		40-44		45-49		50-54		55-59		60-64		65-69		70-74		75-79		80-84		85-89		90-94	
1992																																		
42																																		
Field	—	0	12	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00		
Regulatory classes	—	0	—	0	—	0	0	0	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
All other cases	1	0	0	00	0	00	0	0	0	00	0	0	0	00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total	1	0	12	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00	0	00		

Taxes Grosses, Gross Classes.

Field	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Regulatory classes	0	0	0	00	00	0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
All other cases	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
Total	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

HYGROMETRICAL OBSERVATIONS IN BELFAST WEAVING FACTORIES. May, June, 1893.

TABLE I.

AVERAGE PER-CENTAGE OF OUTSIDE HUMIDITY, 63, being MEAN of PER-CENTAGES varying from 58 to 71.

No. of Factory.	Dry Bulb. Degrees Fahrenheit.	Wet Bulb. Degrees Fahrenheit.	Per-centage of Saturation.	Tempera- ture of Steam at Inlet.	No. of Factory.	Dry Bulb. Degrees Fahrenheit.	Wet Bulb. Degrees Fahrenheit.	Per-centage of Saturation.	Tempera- ture of Steam at Inlet.
1	76	76	100		25	77	76	94	
2	75	75	100			79	78.5	85	
3	74	73	94		28	75	72	84	
5	71	68	88	102°		76	71	75	
6	73	69	79	100°	31	78	72	71	
	76	69	67		32	77	77	100	
7	75	73	89	129°		75	75	100	
	77	72	75			75	75	100	
8	72	69	84	112°		77	77	100	
	74	68	70			77	77	100	
9	77	77	100	131°		77	76	94	
	77	77	100		2	74	74	100	
10	72	72	100			76	75	94	
10	76	75	100	120°	3	75	74	94	
	79	78	95			76	74	88	
	79	77	90		34	80	78.5	92.5	
11	87	82	77	130°		80	79	95	
	85	82	85			81	78	85	
12	87	88	81			83	78	76	
13	77	77	100	112°	1	76	75	94	
14	75	75	100	142°		77	75	89	
	78	75	84			77	75	89	
16	70	68	88	115°		78	77	94	
	71	68	83			79	78	85	
17	77	77	100		30	81	79	90	
	79	78	95			81	76.5	78	
18	72	65	85			81	75.5	74	
19	75	67	62		4	75	71	79	
	76	68	83		41	77	77	100	
20	75	71	79	110°		79	77	90	
21	77	72	76			79	76	87	
23	74	73	94	138°		78	76	89	
	73	72	94			79	78	95	
24	75.5	75.5	100			80	78	90	
	78	78	100						

TABLE II.

DAMASK (JACQUARD) WEAVING FACTORIES (No Steam).

14	71	64	65		36	70	60	58	Cotton W.
16	70	64	69		37	74	70	79	
22	78	70	63						
25	80	76	80		38	72	60	51	
27	70	64	69			74	65	58	
29	71	61	58		40	81	75	72	
30	76	67	59			80	74	71	
33	67	60	64			80	73	67	
35	81	74	68			79	74	75	

TABLE III.

HYGROMETRICAL OBSERVATIONS IN BELFAST WET SPINNING ROOMS.

Reference No.	Dry Bulb. Degrees Fahrenheit.	Wet Bulb. Degrees Fahrenheit.	Percentage of Saturation.	Reference No.	Dry Bulb. Degrees Fahrenheit.	Wet Bulb. Degrees Fahrenheit.	Percentage of Saturation.	
1	85	81	80	10	86	84	90	Fine spinning.
	83	77	72	11	87	83	81	
2	75	75	100	12	80	80	100	
3	78	77	94	13	80	74	71	
	80	78	90	14	80	77	85	Fine spinning. Fine spinning. Coarse spinning.
4	75	72	84	15	79	76	85	
	75	73	89	16	77	70	67	
	79	79	100	17	77	72	75	
5	79	75	80	18	78	72	71	
6	89	85	81	19	79	75	80	
7	81	81	100	20	75	68	66	
8	86	79	68	21	80	75	75	
9	83	75	68					

II.

Supplementary Report of Inquiry into the Conditions of Work in Flax Mills and Linen Factories in the United Kingdom.

SYNOPSIS.

Scope of inquiry.
Sources of information.

Weaving Factories: England and Scotland.

Conditions.
Cleanliness.
Ventilation.
Hygrometry.

Weaving Factories: Ireland.

Humidity.

Wet Spinning Rooms: Scotland and England.

Decay of flax spinning in Leeds.
"Splashboards."
Humidity.
Coarse wet spinning—Ireland.

Wet Spinning Rooms: Ireland.

Bessbrook Co. and Splashboards.
Splashboards general abroad.
Recommended and detail.

Dusty Processes.

Found generally alike.
Results of exhaust from Hackling Room.
Cardrooms unsatisfactory.
Covers on Hackling machines.
Exhaust for drawing frames.

Respirators.

Recommended for children and young persons.

Medical opinions:—

Dr. Keith Anderson, Arbroath.
Dr. Smeddon, Cupar, Fife.
Dr. Will, Aberdeen.
Dr. Key, Montrose.
Dr. Campbell, Dundee.
Dr. Miller, Dundee.
Dr. Keith Anderson, Arbroath, (No. 2).
Dr. St. George, Lisburn.
Dr. Palmer, Newry.
Dr. Boyd, Lifford.
Dr. Taylor, Tinsbridge.
Dr. H. S. Purdon, Belfast.
Dr. Dickson, Ballynahinch.
Dr. Newell, Ligoniel.
Dr. D'Evelyn, Ballymena.
Dr. Dougan, Portadown.

APPENDIX.

Diagrams with Index.

In pursuance of directions to continue the investigation, begun at Belfast, and already reported, in the other chief seats of flax spinning and manufacturing in the United Kingdom, I now beg to present this Supplementary Report.

In the course of this enquiry I have visited practically all representative centres, including Leeds, Kirkham; in Scotland,—Dunfermline, Dysart, Kirkcaldy, Dundee, Arbroath, Cupar, Fife, Aberdeen, Montrose, Forfar, and Kilbirnie; in Ireland—Lisburn, Carrickfergus, Ballymena, Portadown, Lurgan, Newry, Bessbrook, Drogheda, and Strabane. As in the case of Belfast, the conditions of employment in the various processes have been carefully observed, where necessary the humidity of the atmosphere has been thoroughly tested, the appearance of the workpeople scrutinised, and as far as possible their liability or otherwise to special ailments arising from the nature of the work in damp or dusty circumstances ascertained; and in order to give more weight to this portion of the investigation, the results of their actual experience have been obtained from a number of certifying surgeons, who in many cases hold additional appointments, giving them unusual opportunity for accurate observation and extended knowledge of the people among whom they live. Those opinions will be found later on, and it will be seen they tend to confirm the conclusions already drawn independently from observation and enquiry among the factories. In order to narrow the issue to practical points, they were specially desired to confine their remarks to their own experiences, which thus renders their testimony the more valuable.

Through the courtesy of employers, and of ventilating engineers, &c., I am enabled to append diagrams of arrangements that have been found satisfactory here and abroad in lessening dust, &c., also of various forms of splash-board in use in different places.

These are given as sent me, the time at my disposal not permitting their reduction to uniform scale.

In dealing with the various processes, it will be convenient perhaps to take them in the same order as in my former Report on Belfast, and to begin with the weaving factories.

Weaving Factories (Scotland and England).

It may be stated generally that outside Ireland artificial humidity is not produced for the purposes of linen manufacture. This, because either the looms are engaged on damasks as in Dunfermline, or on the coarser classes of flax fabrics where the yarns, not being fine, are little affected, so far as weavability goes, by atmospheric changes. It is impossible to go into a Scotch linen factory in Dunfermline, Kirkcaldy, or Forfar and not be struck by the contrast to weaving sheds in other parts of the Kingdom. They are spacious and lofty, and the machinery has ample room, not being crowded as with us (sites are doubtless cheaper), they are also scrupulously clean; in one case I was told the floor is swept three times in the day and as a natural corollary, the weavers are tidier and more comfortably dressed.

Scotland and England.

In some places also lavatories are provided, well fitted up with brass basins, hot and cold water, &c., where the women can tidy themselves up before leaving work, or at meal times, so that they can do any errands they may wish on the way home, &c. An employer wisely observed, "we find it to our own advantage to make our people as comfortable as possible," and this was a general feeling. In most cases the warp-dressing department is not partitioned off from the remainder of the shed, so that no great heat is produced or requisite. The ventilation at the time of my visit was good of its kind, but in bad or cold weather I imagine must be chiefly closed, as otherwise the down draughts would be great upon the workers; it is here that the advantage of extracting fans comes in, as they not only change the air gradually, but remove the carbonic acid gas of respiration, the ill-effects of gas combustion, where gas is still used, and the fine particles of the fibre which are suspended in the air while the machinery is in operation, besides being available as well in cold weather as when, in summer, the air inside and outside too nearly approaches equilibrium to admit of "natural" ventilation of any effective value. In one instance (Dundee) in one portion of the shed where a fabric was being made, in which the terms of the contract forbade any dressing for the yarns, the weavers towards mid-day had the appearance of having their hair powdered from the amount of fluffy filament which had settled upon them, caused by the trituration of the warp in passing through the reed comb. The bulk of this light fluff would have been removed by fans arranged in the top of the room as in Lancashire cotton cloth factories. In the same shed some attempt was made to temper the atmosphere by forcing air, by a fan, into it, from a spray-chamber where, on occasion, disinfectants could also be combined with the air. I did not find any very sensible impression made by this at the time of my visit, the point of admission was too limited to ensure anything like equable diffusion of the modified atmosphere in so large a room. Hygrometers were here, but not in working order, and the firm had constructed some rough wooden hygrometrical indices set on a quadrant and scaled by comparison with a hygrometer. These were hung about the room, and indicated changes of humidity by the contractibility of the wooden index, on the same principle as the instruments, made in Germany, of thin strips of linden bark. Of course they only give approximations to accuracy. A hygrometrical test showed there was very little humidity present.

Weaving Factories (Ireland).

In the majority of Irish weaving factories outside Belfast artificial humidity is produced, but seldom to the same extent. In none did I find actual saturation as there, in only two cases excess over the 2° of difference proposed, and both these cases were the result of a careless disregard of economy in the arrangement of the steam and of the fact that there is no instrumental check on the process, added to which the carrying pipes were uncovered and the pressure of the steam too high. In some places where similar qualities of linen to those manufactured in Belfast were being made the humidity was well within the proposed limits, occasionally reaching within a half degree, but this was exceptional. The ventilation was by no means satisfactory, for the reasons already fully stated.

Ireland.

Wet Spinning Rooms (Scotland and England).

Very little wet spinning is now to be found in England and Scotland. The spinning of fine flax yarns has almost wholly gravitated to Ireland. In Leeds, where formerly there were some 42 flax-spinning mills, as I am informed, since the great wage dispute which led to the closing of the Messrs. Marshall's Mills, these have dwindled to two, much of the yarn now used being imported from Ghent and other centres. This illustrates how deadlocks of this description, stopping an ordinary channel of trade, give opportunities for keen competitors to come in and establish a commerce that cannot afterwards be diverted when the original dispute may be settled, and so a district may totally lose an industry for lack of conciliatory handling. The most noteworthy feature, however, of the wet spinning in Yorkshire and Scotland is that the frames are fitted with "splash-boards," so as to effectually intercept and carry off the spray from the spindles, consequently the workers are kept dry as well as the floors, and work is carried on with more comfort as well as more cleanliness. It seems remarkable that any wet spinning frames should be without such appliances for these reasons, and even apart from any hygienic considerations. Owing no doubt in great measure to the absence of the large evaporating surface given by a wet floor, I did not find the amount of humidity in the air so great as in the Irish mills, the highest noted being as under:—

Dry bulb	$\left\{ \begin{array}{l} 68^{\circ}\cdot5 \\ 73^{\circ}\cdot5 \\ 75^{\circ} \\ 79^{\circ}\cdot5 \end{array} \right.$	Wet bulb	$\left\{ \begin{array}{l} 67^{\circ} \\ 72^{\circ} \\ 73^{\circ} \\ 70^{\circ}\cdot5 \end{array} \right.$	Per-centage of Saturation.	$\left\{ \begin{array}{l} 91 \\ 92\cdot5 \\ 89 \\ 84 \end{array} \right.$
Fahr.		Fahr.			

In these instances there was no mechanical ventilation, and the trough covers allowed the escape of much steam.

In the wet-spinning rooms of Messrs. Baxter Brothers, Limited, Dundee, the trough covers were of metal. They appeared to fit closer, consequently to permit less escape of steam into the rooms, and to be less likely to get out of repair than the wooden lids in ordinary use.

In the course of a conversation with Mr. J. Smith, of Dysart Mill, on the saturated atmospheres of coarse spinning rooms in Ireland, he informed me he had at one time managed a mill there and dealt with the difficulty. I may quote from the letter he wrote me on the point at my request, "The room referred to was one in which the very coarsest numbers of wet spun yarns were made. In certain conditions of weather I have seen the room so filled with steam that it was impossible to see from one end of the frame to the other, in fact one could scarcely sometimes see even the girls working at the frames; when in this state there was a very large quantity of waste made. Having noticed that on a clear day, when there was plenty of sunshine, there was scarcely any steam in the room and that the work went much more smoothly, I came to the conclusion that if the temperature could be kept uniform, and as little steam put into the room as possible, all would be right, and adopted the following plan with perfect success. I carried two rows of 4½-inch steam pipes along the bottom and top of two adjacent sides of the room, and used the condensed water from these to heat the water in the hot-water troughs: this arrangement kept the room at uniform temperature, and also did away with the heating of the troughs by steam, as the water from the pipes was sufficiently warm for this purpose."

The value of this experience lies in the fact that it was found possible to dispense with the high temperature steam blowing in quantity into the troughs, which causes the saturated and oppressive atmospheres observable in most coarse spinning rooms of Irish mills, and that it thus points to the possibilities of practical improvements.

Wet Spinning Rooms (Ireland).

There is little to add to the details given in regard to those in Belfast, the hygrometrical conditions being precisely similar.

The Beeshbrook Company's mills near Newry, I was glad to find, are fitted with "splash-boards," and Mr. Andrews, the spinning manager, courteously forwarded me a diagram of these, showing the position in relation to spindles. As some doubts were expressed to me as to the willingness of the workers to have these "splash-boards"

applied and the difficulties of cleaning, &c., it will be apposite to quote Mr. Andrews' opinion and experience. He says, "the cleaning is done simply by the girl walking from one end of the frame to the other, and running her hand along to gather the waste; this is only the work of a moment and entails no extra labour on the girl. If one of our splash-boards happens to get broken the girl is always complaining of the wet, and is most anxious to have it on again, and on our very fine frames we thought to do without them, but the girls themselves came and asked me to get them on. 'Cleaning' is about four times a day for fine work and six times for coarse." No one contrasting these girls working in dry clothes and dry footed with the dragged discomfort and always wet feet of those in other mills, can be surprised at their anxiety not to be without these splash-boards.

I learnt from an interview with Mr. Combe, of the celebrated machine-making firm of Combe and Barbour, that most of their spinning frames for export are invariably fitted with splash-boards, which are compulsory in Austria, and required in most foreign countries, and this agrees with information derived from another source that they are usual everywhere in all the mills my informant has visited. It is very desirable they should be compulsory here, wherever the arrangement of the machinery will admit. This depends on the "pitch" of the room, that is, the distance between the columns. The frames are erected opposite the piers, so that the alleys may be opposite the windows for the maximum of light; hence it will be easily perceived that the frames cannot be rearranged, while where the columns are too close there is not room for the splash-boards and for the free passage of workers at adjacent frames. Having gone carefully into this point and the necessary measurements, I am of opinion the compulsory rule should apply in all cases where the distance is not less than 4 ft. 6 in. from the axis of the spindle on one frame to the axis of the spindle on the next frame. Allowing each splash-board a distance of 9 inches from the axis of the spindles, which is ample, there will be a free space of 3 feet, which is sufficient for all practical purposes. The profile diagram Fig. I. in the Appendix is the new form of splash-board for the Besbrook Company, forwarded by Messrs. Mackie and Son, of Belfast, who have also sent me a section of the thin rolled steel "board" itself. Fig. II. is a small sketch of the movable splash-board in use at the Kilbirnie Mills of Messrs. Knox; and Fig. III. the ordinary wooden splash-board in use at Messrs. Briggs, of Leeds.

Dusty Processes.

Dry Spinning Rooms, "Roughing," "Hand-hackling," and "Sorting" Rooms, Machine Hackling Rooms, Preparation and Card Rooms.

These may, for the Report, be grouped together as their special features have already been described in regard to Belfast, and while in Ireland they are much alike in all places, in Scotland, with a very few exceptions, the dusty conditions are generally worse, partly because the mills are old with low rooms, but also because it is quite unusual to find anything like an extracting fan used to diminish dust or to improve ventilation.

From the mode of handling the flax in Scotland, where it generally goes direct to the hackling machines without the preliminary stage of "roughing," &c., there are not many roughing rooms, but those there are urgently require to be dealt with as already suggested. As Russian flax is mostly used for the class of yarns required, and it is complained that this arrives in a dirtier state each succeeding year, it may well be supposed that the hackling involves a considerable amount of dust. Some idea may be formed of the quantity given off from the fact that in the case of the hackling room at Kirkham (Lancashire), shown in Diagram V., which is fitted with three 24-inch Blackman fans, and about 90 feet x 30 feet, the settling room above it of the same dimensions after eight weeks' work contained fine dust to an average depth of $\frac{1}{2}$ inch covered with fine fluff from 2 inches to 5 inches thick.

The card rooms also are extremely bad; in Montrose, where I visited the room about 20 minutes after the dinner-time, it was then hardly possible to see further than the third carding engine (there were 12 or 13), and the women were already covered with dust; the state of things was nearly as unsatisfactory in Arbroath and Aberdeen.

In Scotland many of the card-room hands wear a small kerchief on the head, tying the ends over the mouth sometimes, but it is not fitting or necessary that such an atmosphere should be permissible in any workroom. I have satisfied myself, from observation and inquiry, that the 18-inch fans have not enough power to deal with a card room satisfactorily; it is desirable to use either 30-inch or 36-inch fans, as shown

in the Diagrams IX., X., and XI. The hackling machines in Scotland are frequently tended by females; in Dundee, at the mills of Baxter Brothers, the dust from these machines seemed materially lessened by covering in the "sheet," as it is called (= the endless carding strips that revolve). An effective mode of exhausting the dust from drawing frames was in use at Ward Mills (Dundee), see Diagram VI., though the use of "blowers" instead of fans demands a larger expenditure of driving power. Here the heavier dust gravitates into the outside hopper, while the lighter particles are blown away. But as other preparing machinery is in the same room, for which provision is not made, floating dust was still apparent.

Except in cases where dust is to be drawn downwards, trunks and hoods are not advisable—as a general experience, a free fan will effect more than one enclosed in a tube, added to which bends and angles lessen the power, and in the case of fibres increase risk of fire.

Objections are raised to making the use of respirators compulsory for adult workers; but in my opinion for children and young persons they should be a condition of employment, as they can be very simply and cheaply constructed, since an elaborate appliance is not necessary as with poisonous dusts.

Medical Opinions.

In answer to inquiries as to their actual experience of the ailments of flaxworkers, and whether they had personal knowledge of cases where ill-effects were ameliorated on cessation from the work, and returned on its resumption, I have received from the various certifying surgeons the following replies:—

Dr. Keith Anderson, of Arbroath, writes: "I find that emphysema and chronic bronchial catarrh are of constant occurrence among those adult workers who have to deal with flax in the early stages of its manufacture, viz., flax dressers and tow mill workers. Boys engaged at the hackling machines do not suffer from these complaints, probably because they have to adopt another calling as they grow up, and weavers only after spending many years in the factory."

"I do not find that consumption is more common among textile workers than in other classes of the community."

"Over one-third of the total deaths in Arbroath are due to diseases of the respiratory organs. The Registrar-General's returns for 1892, are as follows:—

"Population 23,151, total deaths 368 (1·580 per cent. of the population); deaths from diseases of the respiratory system, excluding croup and laryngitis, 128, or ·553 per cent. of the population, or 34·780 of the total deaths."

Dr. Sneddon, of Cupar Fife, writes: "I have not the slightest doubt of the ill-effects of the dusty processes in flax mills in inducing and encouraging diseases of the respiratory system, particularly phthisis. In proof of what I state, I append notes of cases."

"1. K. H., aged 18, female, flax spinner, well-nourished, strongly built, seen first in November 1887. She complains of cough, and on inquiry says she has been so troubled for three or four months, and is worse when at work. Night sweating is occasionally troublesome, but not markedly so. There is no family history of phthisis, and no history of any previous illness, &c. She was ordered rest from work, with suitable diet, medicine, and change of air; she rapidly improved, and after two months resumed work, feeling quite well, and on examination showed no signs of lung trouble beyond a slightly harder breathing under left clavicle as compared with the right. Six months after she again complained of cough and loss of flesh. Consolidation was more marked, breath sounds over left apex harsh, and broncho-vesicular in type. Advised to leave her work, and on recovery after rest and change became a domestic servant. Is now married, and as yet has shown no signs of recurrence to former trouble."

"2. J. B., aged 22, male, flaxhackler: Badly nourished, and emaciated looking, complained in summer of 1888 of cough, shortness of breath, and night sweatings, which latter were sometimes profuse. The sputum profuse and muco-purulent. No hereditary tendency to phthisis and no history of former trouble beyond a slight cold now and again. On physical examination all symptoms pointed to incipient phthisis affecting both apices. Cod-liver oil, fresh air, good food, and rest from work quickly produced a marvellous change for the better. He returned to work four months after in quite a plump and healthy condition, and no symptoms beyond a slight increase of vocal resonance over left apex. After two months' work the

" symptoms returned, and he quickly became very ill and quite unfit for work. He rested awhile and then was advised to leave his work and get some out-door occupation. This he managed to do, and, though he never will be strong, he manages to get along without much trouble, but I have not the slightest doubt that were he to resume his former occupation the symptoms would return.

" I might easily multiply cases, but the foregoing, with others of a like nature which have come under my notice, seem to prove that working in flax may both induce and encourage phthisis.

" I have also noticed that many flax dressers and spinners die with symptoms of phthisis between 50 and 60. In one family of four females with no history of phthisis, all of them within the last six years have died of phthisis, the oldest of the four only 62 years of age. In all these four cases there were accelerating causes of death, but the main trouble was phthisis.

" Bronchial catarrh I find very common among workers in flax. When bronchitis occurs it is usually very acute, and deaths about the ages of 40 and 50 are not uncommon. Laryngitis is a frequent source of trouble, and when once started seems to recur with great frequency.

" The diseases I have mentioned are those most commonly found, and it has often occurred to me that something in the nature of fans, or other apparatus for causing draughts, and allowing of a more complete ventilation, might improve the hygienic aspects of flax mills.

Dr. Will, of Aberdeen, states: " After a long experience of flax mills, I have seldom had an employee the subject of phthisis. A number, however, have suffered from bronchitis, notwithstanding that our workrooms are large and admirably ventilated; besides every means have been used for carrying on the work with the least risk to the health of the workers."

Dr. Key, of Montrose, says: " In my opinion and experience the dusty processes do not tend to induce phthisis. But I am satisfied that the dust generated in these works does produce bronchitis, which in the long run assumes a chronic character, and after a time in most cases is complicated with emphysema."

Dr. Lunan, of Blairgowrie, writes: " I cannot say I have been able to trace the origin of phthisis to flax dust. I feel quite sure that bronchial catarrh, accompanied in many cases by asthma, is frequently caused by breathing the dusty atmosphere of flax mills. Elderly persons, and those who have a predisposition to bronchial affections, almost invariably suffer from some form of bronchial affection while they continue working in a flax mill. Hacklers and others employed amongst flax suffer more than those employed amongst tow."

Dr. Campbell, of Dundee, writes: " Our flax mills are very limited, but in those we have, I have no hesitation in saying that the dusty processes tend to a considerable extent to develop phthisis, and especially chronic bronchitis, with heart complications. During 23 years I have noticed this, and more particularly in what is termed the tow mill."

Dr. Miller of Dundee, writes: " My opinion is that there is reason to doubt that the dust of the flax mills exercises any considerable influence in giving rise to phthisis or other lung diseases. Even were it proved that work in the preparing flats of flax mills furnished a larger proportion of phthisis cases than other employments, I would not conclude that the dust was the cause. For these workers are the least skilled and the lowest paid, and as a rule are drawn from the poorest grade of the people, and are consequently more exposed to the combined influences of insanitary houses, bad and insufficient food, and scanty clothing, more potent causes for evil, one can scarcely doubt, than the dust. Looking in at one of these dust flats while work is going on, the impression given is certainly that the occupation must be a very unhealthy one. This view, however, does not appear to be supported by facts.

" Although aware that a single enquiry does not carry much weight, I visited the medical wards of our hospital to ascertain what proportion of the phthisic patients in the house had been engaged in this sort of work. Among the 79 medical cases there were 13 cases of phthisis, the ages ranging from 18 to 59, and of the 13 patients 7 had been employed in the dusty departments of flax and jute factory work.

" Notwithstanding, however, my doubt as to decided injury from the dust, I think that thorough ventilation should be insisted on, and that the workers should be

"urged to wear, as some of them do, a thin protector of some suitable material over the mouth and nose."

In a second communication Dr. Keith Anderson, of Arbroath, adds: "I can testify that I constantly observe in cases of phthisis and chronic bronchitis, a marked improvement in the symptoms coincident with the patients leaving the mill; this improvement coming to a stop at once on resumption of work. I have delayed this note for several days in order to take the opinion of some of my fellow practitioners in the town, and I find that their experience agrees with mine."

Dr. St. George, of Lisburn, who is also surgeon to the Antrim Infirmary, writes: "I find that a large number of hacklers and roughers among males, and carders among females, suffer from phthisis, bronchitis, and asthma due to the irritation caused by the particles of flax being carried into the lungs and causing mechanical irritation. In the wet spinning rooms a number of the spinners and doffers suffer from rheumatism, caused by their having to stand in the warm, damp surface water in their naked feet, and there is also a good deal of anæmia among young girls from the heated and vitiated atmosphere."

Dr. Palmer, of Newry, Co. Armagh, writes, after mentioning the liability of workers in scotch mills to mill fever, and its recurrence: from what I have observed in the spinning and carding rooms, as well as information derived from patients who have consulted me, and from the deaths registered in my capacity as Registrar of the district, I am of opinion that the hot spinning rooms are a fruitful cause of the development of pulmonary consumption, bronchitis, and other chest diseases. This, I believe, to be due to the sudden changes from hot to cold atmospheres that they are subjected to at least three times in the day, viz., at breakfast, and dinner hours, and in the evening when they leave off work. Bronchitic cases are, as a rule, improved, but not cured by leaving off work, and the disease is aggravated by returning to the unhealthy conditions. The phthisical cases rarely return after leaving off work; they usually go from bad to worse till death ends the scene. I should mention that I am of opinion that a large proportion of the employes are as healthy and seem to enjoy their work as much as farm labourers. The carding rooms are also a cause of chest diseases, but not such a large proportion as the spinning rooms. In the spinning rooms there is, I believe, a larger proportion of young girls and boys employed than in the card rooms; this may be, and very probably is, a factor in the phthisical cases, as the girls and boys are subjected to unhealthy conditions at a critical time of their life. Weaving is not, so far as I can ascertain, unhealthy."

Dr. Boyd, of Lifford, Co. Donegal, says: "I have seen some cases of lung disease which I attributed to working in flax mills, but, taking into consideration the numbers of workers there are in this neighbourhood and the character of the work, the cases are very few indeed; in my opinion, where the disease developed is of a phthisical nature, the leaving off work, makes no improvement; but in cases of bronchitic disease there is for the time being, but it is brought on again by the resumption of work."

Dr. Taylor, of Tandragee, Co. Armagh, writes: "In my experience, extending over 14 years, I have never noticed any special ailment attributable to employment at the flax industries here among those employed at them."

Dr. H. S. Purdon, of Belfast, says: "Phthisis, arising in the first instance from inhalation of vegetable dust causing 'mechanical bronchitis,' eventually ending in consumption, is our most common disease. Especially is this the case as regards workers in carding rooms and hacklers. Machine boys are very liable to 'mechanical bronchitis,' and in summer often seek employment in brickfields, so as to be out in the fresh air. Females employed in spinning rooms are liable to varicose veins in legs, often producing again eczematous eruptions by going barefooted both at work, and when returning from or to work, especially in cold weather."

"Onychia or inflammation of matrix of nail, especially that of great toe, is occasionally met with. Formerly—some 25 years ago—this disease was very common, but since most of the workers put on boots on leaving work it is now greatly on the decrease. Young girls, 15 to 19, both in spinning rooms and weaving factories, are liable to anæmia or bloodlessness."

Dr. Dickson, Ballynabinch, Co. Down, writes as follows: "The special ailments I have met with in factory workers are connected with the respiratory organs, and arise more from dust than damp. Bronchitis and bronchial irritation in various

"degrees are the form of disease I consider directly attributable to the work, and these may lay the foundation for more serious diseases as consumption and hemorrhage. Again and again I have got workers to give up dusty departments with marked benefit, and found on their return to their former work a renewal of their old malady.

In a subsequent letter he adds, "I think if the dust fans, which have been erected in some spinning mills, were made compulsory, not only in spinning mills, but also in all scotch mills, it would be a great boon to the workers and save many of them much suffering and premature death."

Dr. R. H. Newett, of Ligoniel, who is dispensary medical officer, besides certifying surgeon, after commenting on the markedly improved atmosphere where fans have already been introduced with a corresponding improvement in diminishing dust troubles, continues, "every industry is attended with dangers to life and to health, more or less peculiar to itself. Among those incidental to flax spinning may be mentioned phthisis, bronchial affections, and among young females of 17 years and upwards anemia; this ailment is an occasional cause of refusal of certificate in the case of girls about 14 years. I meet with very few cases of acute rheumatism, and only a few of muscular or chronic rheumatism. My own opinion is, with which my neighbour Dr. Milligan agrees, that the cases we see cannot be referred to conditions affecting the flax industry as causes. With regard to cases of chronic bronchial ailments, they are benefited by temporary cessation from work, but relapse more or less on its resumption. Several years ago onychia was prevalent among workers in wet spinning rooms; we never see it now. I cannot account for this, as I am informed no change has taken place in the conditions of work." (Dr. Purdon supplies an adequate reason.) "Aluminaria is very prevalent amongst the workers; it cannot be referred to the industry as a cause. The wet clay soil, wet atmosphere prevalent at times, bad habits as to clothing, intemperance, and insanitary dwellings are the causes."

Dr. Alex. D'Ervalyn, of Ballymena, Co. Antrim, after pointing out the dustiness, and absence of mechanical ventilation in scotch mills, says, "With regard to the preparations for spinning, the hackling, which is done by hand, is the most deadly process, notwithstanding the fact that there is generally good ventilation. The *hacklers* all *déjeuné*, and all suffer from chronic disease of the lungs, caused by the flax dust or '*ponce*' as it is locally named. Many of these men succumb to cirrhosis of the liver, or to disease of the kidneys, but this is partly due to the amount of raw alcohol which they consume. The first thing a hackler does each morning is to drink a glass of raw whiskey, to clear out his bronchial tubes, otherwise he is unable to breathe. After a day off, the men have often told me that their breathing is worse. In the machine hackling and other preparing rooms which are dusty the workers suffer more or less from lung trouble, but as they are generally young persons or children, I do not meet so many cases of disease among them."

"In the damp processes, such as spinning and weaving, many of the workers contract consumption, but this I consider is due to a great extent to the fact that they go straight from the warm, moist air of the spinning room or weaving shed into perhaps a cold, frosty air outside, without any additional clothing, excepting perhaps a light shawl. In conclusion, I may safely say that all the workers in our flax-spinning mills suffer in some degree from lung trouble due to the '*ponce*.' In some cases it does little harm, but in others it causes congestion of the lungs, and if the person so affected continues in the dusty atmosphere it leads most certainly to a form of phthisis or consumption."

Dr. Dougan, of Portadown, writes:—"I have frequently had cases of pulmonary disease, which I attributed to bronchial irritation from dust, and I have seen persons suffer from ulcers on the legs and feet, especially the toes, from damp. However, everything considered, they are wonderfully healthy in my district."

The general consensus of these opinions appears to justify and corroborate the inferences already drawn, particularly in regard to the dusty employments, which can undoubtedly be much ameliorated by the adoption of judicious and adequate methods, some of which are shown in the appended diagrams, and these qualifications are added designedly, because instances of their opposites have come under my notice where there has been clear desire to have the best results, for there is no doubt that the employers are, as a body, anxious to improve the conditions under which work is carried on for their own advantage as well as for the welfare of their people.

It is quite possible that large modifications of existing conditions may and do give rise to cavil and objection, but it is my experience that when they have been carried out objectors are often the readiest to acknowledge the practical advantages. This I feel certain will be the case with regard to the use of "splashboards" in the wet-spinning rooms, and the diminution of dust in other processes. But it must be borne in mind that in treating textile fibres for manufacturing purposes some amount of dust is unavoidable; hence when the employers have done what lies in their power it would also seem right and reasonable that the workpeople themselves should exercise a contributory care of their own health, and take such due precaution on their own behalf as lies within their power. The objection to wear respirators, as a case in point, is not creditable to their intelligence. If it were overcome, I do not think employers would be unwilling to provide them, nor would the expense be great in comparison with the comfort and the benefit of immunity from distressing and often permanent forms of disease. Though these are days of abundant peripatetic philanthropy, woman's duties in such cases appear to have escaped attention. They might perhaps fairly engage the efforts of local ladyhood. The simplest form of appliance would be effective; two folds of muslin, with a removable layer of cotton wool between, kept away from the mouth (to avoid saturation) by a light wire concave oval, would answer every practical purpose, and be within the power of any ordinary needlewoman to contrive and keep in order, and so far as appearance constitutes an existent objection, feminine instincts might be trusted to arrive at even a decorative result. But in any event it is desirable the respirator should become a strict condition of employment of children and young persons in what have been shown to be the dusty departments in the manipulation of the flax fibre.

R. H. OSBORN.

APPENDIX.

SHORT NOTES upon HYGROMETERS, ARRANGEMENT OF FANS, and RESPIRATORS.

(DIAGRAMS.)

- I.—Splashboard (Bambrick Flax Spinning Co.), with section of new rolled steel "board."
- II.—Movable splashboard (W. & J. Knox, Killybegs).
- III.—Ordinary wooden splashboard (Messrs. Briggs, Leeds).
- IV.—Improved method of removing dust from roughing room (York Road Mills, Belfast).
- V.—Method of ventilating and removing dust from machine heckling room (Kirkham Mills).
- VI.—Method of exhausting dust from drawing frames (Don, Baist, & Co., Ward Mills, Dundee).
- VII.—Method of removing dust from roughing room (New Northern Co., Belfast).
- VIII.—Same in section.
- IX.—Method of ventilating and removing dust from card room (St. Mary's Flax Mills, Drogheda).
- X.—Method of ventilating and removing dust from card room (Messrs. Lorent Lescaur, Lille, France).
- XI.—Method of ventilating and removing dust from card room (Messrs. Crepy et Cie, Lille, France).
- XII.—Method of ventilating and removing dust from card room (Black Forest District).

Short Notes upon Hygrometers, Arrangement of Fans, and Respirators.

HYGROMETERS.

The hygrometer consists of two standardised thermometers, which have been compared at Kew Observatory with a standard thermometer to determine their index errors, which are stated in tenths of a degree on the Kew certificate which accompanies each.

The bulbs should be small to be sensitive, and the degrees marked upon the stems, and they should be so mounted that there is a distance of at least $3\frac{1}{2}$ inches between the bulbs, in order that the evaporation from the wet bulb or from the water reservoir may not affect the dry bulb, and render its readings inaccurate to the disadvantage of the user.

The water reservoir should have a very small aperture to receive the conducting thread, or better, be provided with a copper cover with a small hole for the conducting thread; and the bulb of the wet thermometer should be covered with thin muslin—a bleached “India” muslin is best for the purpose—and round the neck of the bulb, a conducting thread of common coarse darning or crochet cotton is loosely tied to secure the muslin.

The reservoir must be kept supplied with soft, rain, or distilled water; and the covering and conducting thread should be renewed every Monday morning, as if either becomes dirty or dry the readings will also be affected to the prejudice of the user.

The use of bleached materials is desirable as freed from any grease acquired by the yarn when being spun, which hinders the free capillary action of the water.

To cover the wet bulb, cut a small circle of muslin about the size of a halfpenny, rinse it well and fit closely round the bulb, then take a single thread of the darning cotton, wetted thoroughly, and tie it loosely round the neck of the bulb, not in a knot, but so as to secure the muslin, and enter the two ends into the reservoir so as not quite to reach the bottom; the bulb will at once begin to act, and in 10 minutes give a correct reading.

It is not desirable to tie the muslin tightly with a fine thread, or to use a large quantity of conducting threads, as is often the case when the instruments are sent out by the makers.

The hygrometers should be so fixed as to be easily read with a level eye, and should not be on a damp wall, nor should an instrument be used which has the longitudinal reservoir mounted between the two stems.

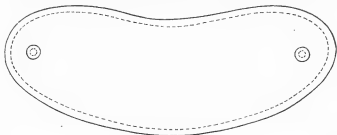
VENTILATION.

In the ventilation of weaving sheds, the small fans should be symmetrically arranged, so that each may as nearly as possible have an equal area of work; they should be fixed with a vertical spindle, and so that the fan will be working horizontally at about 8 or 10 inches below the gutter-line; this gives a horizontal and diagonal draw upon the air, removing continuously the foul and dry upper strata of atmosphere without causing any draught upon the workers, while at the same time the humidity will be diffused more equally than is possible by any other means. The use of large fans set on one side of a weaving shed does not produce a satisfactory result, as they draw the heat or moisture towards themselves, and cause little effect at any distance, since every loom-strap interferes with their action, and is always setting up a small current in its own direction. Inlets on the Tobin principle should be provided at the sides of the shed, introducing air at about 7 feet from the ground.

To secure satisfactory results, it will be desirable that the plan of arrangement be submitted to the inspector for approval.

RESPIRATORS.

No elaborate or expensive form is necessary. The accompanying drawing shows a cheap, simple, and effective type, which is made of two thicknesses of fine flannel,



bound with tape or ribbon, can be fitted with elastic loops to pass over the ears, or with strings of broad tape to pass round the head and tie in front, and can be easily cleaned.

E. H. OSBORN.

SPLASHBOARD OF ROLLED STEEL AND BRACKET, FOR WET SPINNING FRAMES AT BESSBROOK
 AS FITTED BY
 J. MACKIE & SON, BELFAST.

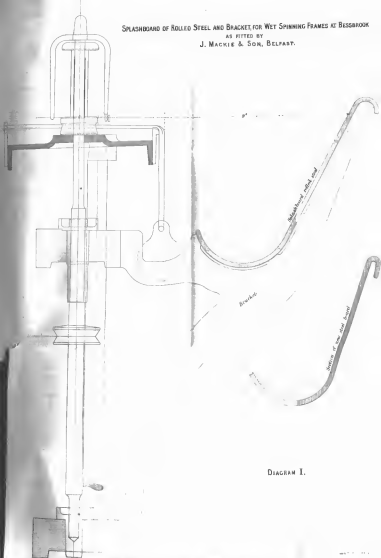
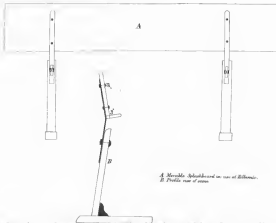


DIAGRAM I.

— DIAGRAM II. —



— DIAGRAM III. —

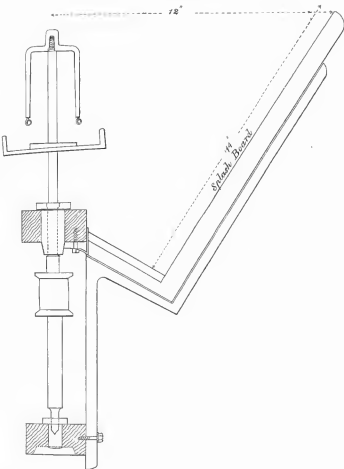
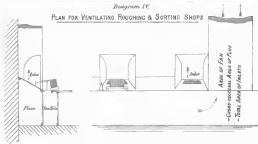


Diagram IV.

PLAN FOR VENTILATING ROUGHING & SORTING SHOPS



Work Road Mill

— DIAGRAM V —



FRONT ELEVATION

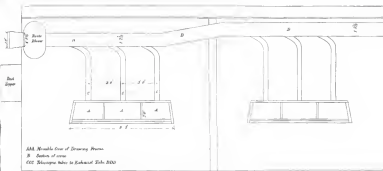


LONGITUDINAL SECTION

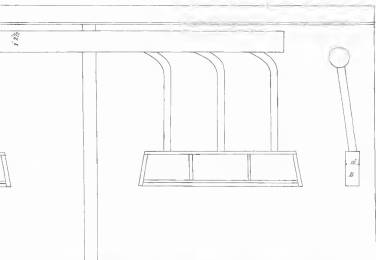


HECKLING SHED DOOT MOVING SYSTEM
OF FRONT AND REAR FLOOR

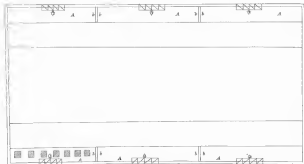
ARRANGEMENT NO. 24th BLACKMAN FANS
FOR MOVING DOOT FROM HECKLING SHED



T WARD MILLS, DUNDEE. —



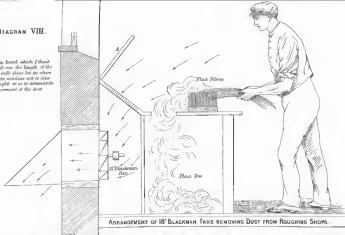
— DIAGRAM VII —



Proposed mode of extracting steel from Roughing Shop of New Northern Mill, Belvidere, by B. Blackman & Sons
Abbbb represents the exhaust break separated by Abbbb, so as to give each fan an equal share of work
Not to Scale

DIAGRAM VIII.

A is a board which I should stretch over the length of the room with plane bed so where opposite windows cut in to intercept light so as to communicate the movement of the dust.



ARRANGEMENT OF 18 BLACKMAN FANS REMOVING DUST FROM ROUGHING SHOPS

PLAN & ELEVATION OF A LINEN CARD ROOM, SHOWING METHOD OF VENTILATING SAME,
AS CARRIED OUT BY
HARRISON & YAPES LTD CYCLOPS WORKS, SWINTON MANCHESTER

DIAGRAM IX.

CARD ROOM OF THE ST MARYS FLAX SPINNING CO BROGHEDA IRELAND



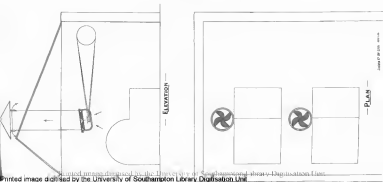
Scale 1/4" = 1 foot

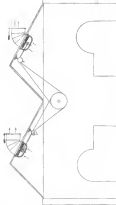


Prevailing Wind S.W.

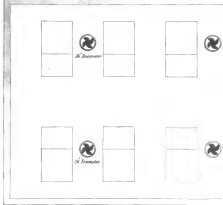
— METHOD OF VENTILATING LINEN CARD ROOM BY THE 'CYCLONE' AIR PROPELLER —
— ADOPTED BY MESS^{RS} LORENT LESCORNEZ LILLE, FRANCE. —

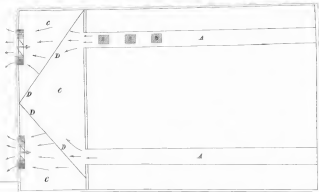
— Scale $\frac{1}{4}$ inch = one foot. —





— ELEVATION —





Rough Plan of good route of Ventilation Card Room (Show the Black Forest).

At ducts under floor DDD openings in ducts are taken each Carding Machine.

The air exhausted by the two W's shown, draws dust into chamber CCC.

DDDD are two fine wire screens which permit dust to pass through, retaining fibres in irregular position.